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8. Proposed by ALFRED HUME, C. E., D. Sc., Professor of Mathematics in the University of Mississippi.

A heavy bar AB of length a falls about its lower end B from a vertical to a horizontal position, when the end A is suddenly fixed and B is set free, so that the bar falls into a vertical position AB as at first; then A is set free, and B is fixed, so that the bar again falls about B into a horizontal position, when the end A is suddenly fixed, and B is set free and so on; find the angular velocity w of the bar about the upper end, when it takes a vertical position for the n th time.

[Selected from *Price's Infinitesimal Calculus*.]

Solution by the PROPOSER.

Let m be the mass of the rod and I its moment of inertia about one end. Let w_1, w_2, w_3 , etc. be the angular velocities immediately before the successive impacts; w'_1, w'_2, w'_3 , etc. the angular velocities immediately after.

When the rod reaches a horizontal position for the first time its *vis viva* is Iw_1^2 ; the work done by gravity, $\frac{1}{2}a.mg$.

$$\therefore Iw_1^2 = mag, \frac{1}{2}ma^2w_1^2 = mag, w_1^2 = \frac{3g}{a}.$$

If r is the distance from the end of the rod now set free to any element of length dr ,

$$w'_1 = \frac{\text{moment of impulses}}{\text{moment of inertia}} = \frac{\int_0^a (a-r)r.w_1 dr}{I} = \frac{w_1}{2}, \text{ the density and}$$

cross-section of the rod being taken as unity.

The principle of *vis viva* gives $I(w_2^2 - w'^2_1) = mag = Iw_1^2$.

$$\therefore w_2^2 = \frac{5}{4} w_1^2 = \frac{15g}{4a}. \quad w_2^2 \text{ is the angular velocity with which the rod}$$

reaches a vertical position for the first time. The impact which now occurs

causes a diminution of the angular velocity of one half, so that $w'_2 = \frac{w_2}{2}$.

As before, $I(w_3^2 - w'^2_2) = mag = Iw_1^2$.

$$\therefore w_3^2 - w'^2_2 = w_1^2 \text{ which, by substitution, gives } w_3^2 = \frac{63g}{16a}.$$

Similarly, just before the next impact, when the rod becomes vertical

the second time, $w_4^2 = \frac{255g}{64a}$.

Again, $w_5^2 = \frac{4095g}{1024a}$, and so on.

The law of increase can be seen from the following:—

(Angular velocity)² when rod reaches vertical 1st time

$$= \omega^2_2 = \frac{15g}{4a} = \frac{4g}{a} \cdot \frac{15}{16}.$$

(Angular velocity)² when rod reaches vertical 2nd time

$$= \omega^2_4 = \frac{4g}{a} \cdot \frac{255}{256}.$$

(Angular velocity)² when rod reaches vertical 3rd time

$$= \omega^2_6 = \frac{4g}{a} \cdot \frac{4095}{4096}.$$

.....
 $\therefore$ (Angular velocity)² when rod reaches vertical n th time

$$= \frac{4g}{a} \cdot \frac{4^{2n}-1}{4^{2n}} = \frac{4g}{a} \left[1 - \left(\frac{1}{4} \right)^{2n} \right].$$

The result given by Price is $\frac{4g}{a} \left[1 + \left(\frac{1}{4} \right)^{4n-2} \right].$



DIOPHANTINE ANALYSIS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTION TO THE CELEBRATED INDETERMINATE EQUATION.

$$x^2 - Ny^2 = \pm 1.$$

By A. H. BELL, Hillsboro, Illinois.

[Continued from the May Number.]

Well known Formulas employed to shorten the computations.

The No. of Terms of the series is nearly equal to $(D_1 \div D_2 + 1)2 = (J).$

The convergent Series for the n th Term is, $S_n = S_1 + (M-1)(n-2) \frac{D_2}{2} + (n-1)D_1 = (K).$

The Series of the m^s and n^s for the n th Term is; $M_n = M_1 + (n-1). \text{ Com. Diff. } = (L).$

PROCESS: Having the number of Terms by (J) ; obtain the conv. Diff. for $(n-1)^{th}$ Term by (K) ; then add the D_1 or the 1st order of Difference for this Term will give the n th term; if the two convergent differences are of